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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/733,133	12/08/2000	Jung S. Yi	C-2377A	4000

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EXAMINER
TSANG FOSTER, SUSY N

ART UNIT	PAPER NUMBER
1745	7

DATE MAILED: 03/27/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/733,133	Applicant(s) YI ET AL.	
	Examiner Susy N Tsang-Foster	Art Unit 1745	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *13 January 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-21* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *3 and 4* is/are allowed.

6)☒ Claim(s) *1,5-12 and 14-21* is/are rejected.

7)☒ Claim(s) *2 and 13* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *6* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Response to Amendment

1. This Office Action is responsive to the amendment filed on 1/13/2003. Claims 1, 7, 14, 17, 19, and 20 have been amended. Claims 1-21 are pending. This Office Action is made non-final as new grounds of rejection are made that are not necessitated by applicants' amendment.

Information Disclosure Statement

2. The information disclosure statement filed on 1/13/2003 has been considered by the Examiner.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claim 7 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 7, the limitation "one support plate has a diameter such that when the pressure differential between said oxidant reactant gas stream and said coolant stream is equal to said predetermined pressure differential, a greater percentage of the pores contain oxidant gas rather than coolant" is indefinite because it is unclear how the pores of the one support plate on the anode side would affect the amount of oxidant gas in the pores of the anode support plate.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 1, 5-12, 14, 15, 17, and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dufner et al. (US Pat. No. 6,024,848) in view of Wilson (US 5,641,586).

Dufner et al. disclose a fuel cell power plant comprising:

(a) a fuel cell comprising an anode support plate and a cathode support plate and a membrane electrode assembly disposed between the anode and cathode support plates, the membrane electrode assembly comprising a polymer electrolyte membrane, both support plates comprising a hydrophilic substrate layer having pores therein (see Figures 1-2; col. 5, lines 34-36; col. 8, lines 57-65); and

(b) a first and second water transport plates adjacent to each of the anode support plate and cathode support plates respectively, each water transport plate having a passageway for a coolant stream and another passageway for each reactant gas stream for the cathode and anode respectively, wherein the water transport plates have a mean pore diameter of 1-3 microns and a pore volume of about 25-40 % (Figures 1-2 and col. 9, lines 1-5); and

(c) means for creating a predetermined pressure differential between the reactant gas stream and the coolant stream by operating coolant water passing through the water transport plates at a pressure differential about 2 to 3 psi less than that of the reactant fluid (col. 8, lines 19-21).

The support plate can further comprise a diffusion layer (the contact bi-layers 44, 48 in Figure 2 of Dufner et al.) disposed between the hydrophilic substrate layer and the membrane electrode assembly. The diffusion layer is partly hydrophobic and partly hydrophilic (col. 6, lines 24-50). The diffusion layer comprises a fluoropolymer, thereby rendering the diffusion layer at least partially hydrophobic (col. 6, line 35-37).

The porous carbon substrate comprises tin oxide or aluminum oxide to render the porous carbon substrate hydrophilic (col. 8, lines 25-35).

The porous hydrophilic substrate layer can be a porous carbon material or substrate sold under the brand name "TGP-H-060" (col. 7, lines 55-60), which is identical to that used by the applicants. Therefore, the porous substrate layer made from "TGP-H-060" inherently has an average pore size of about 27 microns to 37 microns as disclosed by applicants in the specification. Applicants also disclose in the specification using water transport plates having a mean pore size of about 2 to 3 microns and a porosity of about 35% to 40%, which are nearly identical to the water transport plates of Dufner et al. (col. 9, lines 1-5).

Since identical water transport plates, hydrophilic porous substrate layer, and pressure differential between the reactant gas and coolant stream are used in Dufner et al. as those of the applicants, the fuel cell power plant of Dufner et al. inherently has a greater percentage of pores within the hydrophilic substrate containing reactant gas rather than coolant and the predetermined pressure differential between the reactant gas stream and the coolant stream is inherently equal to about 30/D where D is measured in microns and P is measured in pounds per square inch.

Dufner et al. do not teach that the reactant passageways of the water transport plates are interdigitated.

Wilson et al. teach interdigitated reactant passageways in a flow field plate adjacent a porous substrate layer in a fuel cell because interdigitated passageways minimize traverse paths of the reactant gas and distributes the reactant relatively uniformly to the electrode (col. 4, lines 1-7).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have the configuration of the reactant passageways of the water transport plate to be interdigitated because interdigitated passageways minimize traverse paths of the reactant gas and distributes the reactant relatively uniformly to the electrode.

7. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dufner et al. (US Pat. No. 6,024,848) in view of Wilson (US 5,641,586) as applied to claim 6 above, and further in view of Bett et al. (US Pat. No. 5,840,414).

Dufner et al. disclose all the limitations of claim 8 (see above) except that the porous carbon substrate layer comprises an oxide selected from the group consisting of niobium oxide, ruthenium oxide, tantalum oxide, and titanium oxide, that the porous carbon substrate layer comprises a hydroxide selected from the group consisting of tin hydroxide, aluminum hydroxide, niobium hydroxide, ruthenium hydroxide, tantalum hydroxide, and titanium hydroxide, and that the porous carbon substrate layer comprises an oxyhydroxide selected from the group consisting

of tin oxyhydroxide, aluminum oxyhydroxide, niobium oxyhydroxide, ruthenium oxyhydroxide, tantalum oxyhydroxide, and titanium oxyhydroxide.

Bett et al. teach wettability preserving compounds for the porous carbon support layers of PEM fuel cells wherein the wettability preserving compounds are selected from the group consisting of oxides or hydroxides of aluminum, tin, niobium, ruthenium, tantalum, titanium or mixtures thereof (col. 3, lines 60-67).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use metal oxides or metal hydroxides of Bett et al. because they are equivalent to the tin oxide and aluminum oxide used by Dufner et al. to impart wettability to the porous carbon substrate.

It would have also been obvious to one of ordinary skill in the art at the time the invention was made to use the oxyhydroxides selected from the group consisting of tin oxyhydroxide, aluminum oxyhydroxide, niobium oxyhydroxide, ruthenium oxyhydroxide, tantalum oxyhydroxide, and titanium oxyhydroxide because these oxyhydroxides are readily formed from their corresponding metal hydroxides or metal oxides depending on the environment of the fuel cell.

8. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dufner et al. (US Pat. No. 6,024,848) in view of Wilson (US 5,641,586) and Edlund et al. (US 6,376,113 B1).

Dufner et al. in combination with Wilson teaches all the limitations of claim 19 (see above) except that the flow rate of air is maintained at an oxidant stoichiometry of 250% or less and operating the fuel cell at a maximum current density of at least 1.6 amps per square centimeter in response to corresponding electrical loads across the fuel cell which requires at

least 1.6 amps per square centimeter and alternatively operating the fuel cell at current densities of less than 1.6 amps per square centimeter in response to related electrical loads across the fuel cell which requires less than 1.6 amps per square centimeter.

Wilson teaches a conventional 5 cm^2 PEM fuel cell with a standard gas diffusion backing and interdigitated flow fields in Figure 6 which shows that the current density can vary from 0 to about 2.0 amps for square centimeter for a standard gas diffusion backing.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to operate the fuel cell at a maximum current density of least 1.6 amps per square centimeter in response to electrical loads across the fuel cell because current technology enables at least 1.6 amps per square centimeter output from a fuel cell and to operate the fuel cell at less than 1.6 amps per square centimeter because the current density output of the fuel cell is directly dependent on the electrical load on the fuel cell. The heavier the electrical load, the higher the current density output of the fuel cell will be and vice-versa.

Edlund et al. teach that excess air is typically flowed through the cathode of a fuel cell at 200% to 300% of the stoichiometric requirement of oxygen to support the magnitude of electrical current produced by the fuel cell and that flow rates outside this range may also be used (col. 3, lines 60-67).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to control the rate of air to maintain an oxidant stoichiometry of 200% to 300% oxygen because an excess of oxygen is typically used to support the magnitude of electrical current produced by the fuel cell.

9. Claims 20-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wilson (US 5,641,586) and Edlund et al. (US 6,376,113 B1).

Wilson disclose a method operating a PEM fuel cell system comprising a plurality of fuel cells, each having a cathode support plate, an anode support plate, a membrane electrode assembly disposed between the support plates, an oxidant flow channel field on the cathode side of the membrane electrode assembly, and a fuel flow channel field on the anode side of the membrane electrode assembly and the flow fields can have interdigitated flow channels (See Figures 1B and 1C; col. 3, line 26 to col. 4, line 33).

The fuel cell can be operated at a maximum current density of at least 1.6 amps per square centimeter in response to corresponding electrical loads across the fuel cell which require at least 1.6 amps per square centimeter and can be alternatively operated at a maximize of less than 1.6 amps per square centimeter in response to related electrical loads across the fuel cell which require less than 1.6 amps per square centimeter (see Figure 6).

Wilson does not disclose that the flow rate of air is maintained at an oxidant stoichiometry of 250% or less or at an oxidant stoichiometry of 167% or less.

Edlund et al. teach that excess air is typically flowed through the cathode of a fuel cell at 200% to 300% of the stoichiometric requirement of oxygen to support the magnitude of electrical current produced by the fuel cell and that flow rates outside this range may also be used (col. 3, lines 60-67).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to control the rate of air to maintain an oxidant stoichiometry of 200% to 300%

oxygen because an excess of oxygen is typically used to support the magnitude of electrical current produced by the fuel cell.

It would have also been obvious to one of ordinary skill in the art at the time the invention was made to control the rate of air to maintain an oxidant stoichiometry of 167% or less because an excess of oxygen is typically used to support the magnitude of electrical current produced by the fuel cell and the stoichiometry of the oxidant also depends on the amount of hydrogen used to support a certain specific utilization ratio of the reactants in the fuel cell.

10. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Reiser (US 5,700,595) in view of Wilson (US 5,641,586).

Reiser discloses a fuel cell power plant comprising a fuel cell comprising a porous anode support plate 25 and a porous cathode support plate 24 and a membrane electrode assembly (21, 22, 23) disposed between the anode and cathode support plates, the membrane electrode assembly comprising a polymer electrolyte membrane disposed between two catalysts(see Figure 3).

A porous water transport plate (26) is adjacent to both the support plates and the porous water transport plate has a passageway for a coolant stream to pass and a passageway for reactant gas to enter and exit therefrom (see Figure 3) and means for creating a predetermined pressure differential between the reactant gas stream and the coolant stream such that the pressure of the reactant gas stream is greater than the pressure of the coolant stream (col. 4, lines 27-47).

Reiser does not teach that the reactant passageways of the water transport plates are interdigitated.

Wilson et al. teach interdigitated reactant passageways in a flow field plate adjacent a porous substrate layer in a fuel cell because interdigitated passageways minimize traverse paths of the reactant gas and distributes the reactant relatively uniformly to the electrode (col. 4, lines 1-7).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have the configuration of the reactant passageways of the water transport plate to be interdigitated because interdigitated passageways minimize traverse paths of the reactant gas and distributes the reactant relatively uniformly to the electrode.

Response to Arguments

11. Applicant's arguments with respect to claims 1-21 have been considered but are moot in view of the new ground(s) of rejection.

Allowable Subject Matter

12. Claims 3 and 4 are allowed.

13. Claims 2 and 13 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

14. Any inquiry concerning this communication or earlier communications should be directed to examiner Susy Tsang-Foster, Ph.D. whose telephone number is (703) 305-0588. The examiner can normally be reached on Monday through Thursday from 9:30 AM to 8:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached at (703) 308-2383. The phone number for the organization where this application or proceeding is assigned is (703) 305-5900.

The fax phone numbers for the organization where this application or proceeding is assigned is (703) 872-9310 for regular communications and (703) 872-9311 for After-Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

st/23 March 2003

Amy Isang Foster